

The Model includes two types of operating expenses: network-related and non-network-related. The Expense Module relies on historical data from ARMIS reports filed by the company under study to develop factors that can be applied to the investment outputs of the model to estimate network-related and non-network-related operating expenses in the Hatfield Model.

c) Network-Related Expenses and Expense Factors

The Expense Module assigns network-related expenses to each of eleven Basic Network Functions ("BNFs") plus public telephone terminal equipment. The module also assigns the cost of capital, expenses, total investment and attributable support expense to each BNF.

These operating expenses are added to the annual capital cost derived from the NPV to determine the total Expense Summary for each BNF. Each network-related expense is described below:

Network Support -- This category includes the expenses associated with motor vehicles, aircraft, special purpose vehicles, garage and other work equipment.

Central Office Switching -- This includes end office and tandem switching as well as equipment expenses.

Central Office Transmission -- This includes circuit equipment expenses applied to transport investment.

Cable and Wire -- This category includes expenses associated with poles, aerial cable, underground/buried cable and conduit systems. This expense varies directly with capital investment.

Network Operations -- The Network Operations category includes power, provisioning, engineering and network administration expenses.

d) Non-Network-Related Operating Expenses and Expense Factors

The Expense Module assigns non-network related expenses to each density range based on its proportion to total expenses in each category. Each of these expenses is described below:

Variable support -- Historical variable support expenses for LECs are substantially higher than those of similar service industries operating in more competitive environments. Based on studies of these variable support expenses in competitive industries such as the interexchange industry, the model applies a conservative ten percent (10%) variable support factor. Furthermore, it was verified that the support expenses captured by this factor are genuinely variable with operational scale. A regression analysis

was undertaken utilizing 1995 ARMIS 43-02 Holding Company data. This analysis regressed Corporate Operations expense (the dependent variable) as a function of revenues (a surrogate for total costs) less Corporate Operations expense (the independent variable). This analysis demonstrated that fixed support expenses were not statistically significantly different from zero; and that a fixed percentage amount for variable support expense was appropriate.

General Support Equipment -- The Investment Module calculates investments for furniture, office equipment and general purpose computers. The Model uses actual 1994 company investments to determine the ratio of investments in the above categories to total investment. The ratio is then multiplied by the total local service investment estimated by the Model and treats the result as an additional investment needed to provide local service. The recurring costs of these items are then calculated in the same way as recurring costs for investment categories estimated directly by the investment module of the Model.

e) Revenues

The only clearly used revenue figure is that for calculating the uncollectables factor. This factor is a ratio of uncollectable expense to adjusted net revenue.

4. Outputs of the Expense Module

Results of the Expense Module are displayed in a series of reports which depict detailed investments and expenses for each BNF for each density range, summarized investments and expenses for all BNFs, unit costs by BNF and total annual and monthly network costs. These are presented in Section IV, below.

Basic Network Function (BNF) outputs

The Hatfield Model produces cost estimates for eleven Basic Network Functions ("BNFs"), plus public telephone terminal equipment. These BNFs represent an unbundling of the local exchange network into discrete functions, which can be used singly or in combination to furnish services. The BNFs are described below and their inter-relationships are illustrated in Figure 7.

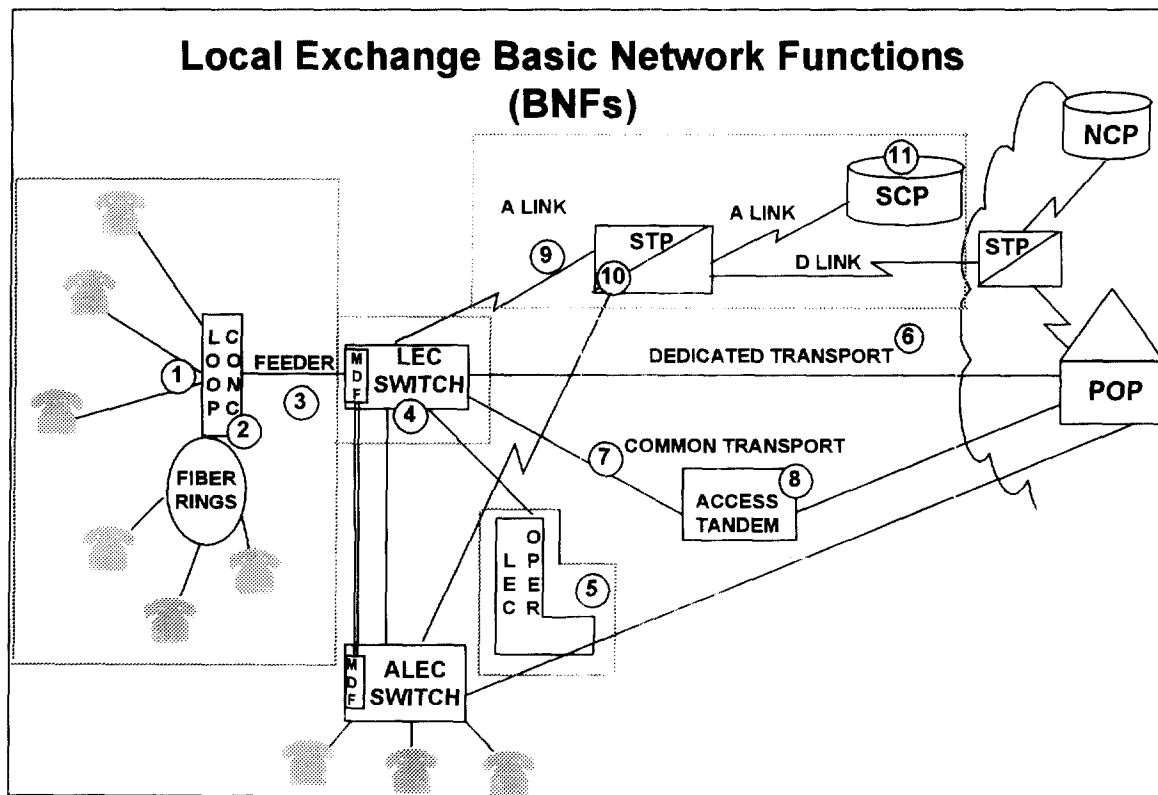
1. *Loop Distribution* -- The individual communications channel to the customer premises originating from the DLC remote terminal or SAI and terminating at the first point of termination at the customer's premises. In the Hatfield Model, this BNF also includes the investments in NID, drop and terminal/splice
2. *Loop Concentrator/Multiplexer* -- The DLC remote terminal at which individual subscriber traffic is multiplexed/de-multiplexed and connected to loop distribution for

termination at the customer's premise. The Hatfield Model DLC equipment investment in this BNF.

3. *Loop Feeder* -- The facilities on which subscriber traffic is carried from the line side of the wire center switch to the Loop Concentration facility. The BNF includes copper feeder and fiber feeder cable, plus associated structure investments (poles, conduits, etc.)
4. *End Office Switching* -- The facility which provides the functionality required to connect appropriate lines or trunks to and from a desired communications path at the first point of switching. This functionality include such things as testing, translation and routing. As modeled in the Hatfield Model, this BNF includes the end office switching machine investments and associated wire center costs, including distributing frames, power and land and building investments
5. *Operator Systems* -- The systems that provide for the processing and recording of special toll calls, public telephone toll calls and other types of calls requiring operator assistance, as well as Directory Assistance. The investments identified in the Hatfield Model for the Operator Systems BNF include the operator positions (e.g., personal computers), operator tandem investments (including required subscriber databases), wire center and operator trunks.
6. *Dedicated Transport* -- The full period, bandwidth specific interoffice transmission path between LEC wire centers or between LEC wire centers and an IXC Point of Presence ("POP"). It provides the ability to send individual and/or multiplexed switched and special services traffic between wire centers. Interoffice transport investments that provide dedicated transport are assigned to this BNF.
7. *Common Transport* -- A switched trunk between two switching systems on which traffic is commingled to include traffic to and from multiple IXCs, as well as LEC traffic. These trunks may originate at an end office and terminate at a tandem switch, or at another end office. Interoffice transport investments that provide common transport are assigned to this BNF.
8. *Tandem Switching* -- The facility that provides the function of connecting trunks to trunks for the purpose of completing inter-switch calls. Similar types of investments as are included in the End Office Switching BNF are also reflected in the Tandem Switching BNF
9. *Signaling Links* -- Transmission facilities in a signaling network which carry all out-of-band signaling traffic between the switches and STPs, between STPs and between STPs and SCPs. Signaling link investment is developed by the Hatfield Model and assigned to this BNF

10. *Signal Transfer Point ("STP")* -- This facility provides the function of routing TCAP and ISUP messages between network nodes (end offices, tandems and SCPs). The Model estimates STP investment and assigns it to this BNF.
11. *Service Control Point ("SCP")* -- The node in the signaling network to which requests for service handling information (e.g., translations for local number portability), are directed and processed. The SCP contains service logic and customer specific information required to process individual requests. Estimated SCP investment is assigned to this BNF.

Figure 8 Local Exchange Basic Network Functions



IV. ILLUSTRATIVE MODEL RESULTS

A. OVERVIEW

This section displays illustrative outputs of the HM. The main outputs exhibited are the TSLRICs of the eleven BNFs, the unit volumes of these BNFs and the monthly TSLRIC per unit of these BNFs. These outputs are further disaggregated across density zones for the loop BNFs

The unit TSLRIC of the BNFs are then processed to develop an estimate of the unit TSLRIC of the collection of these BNFs that comprise switched local service and carrier access service.

There are several reasons why a TSLRIC for switched local service plus carrier access is not the simple sum of the complete collection of BNFs. This is due largely to the fact that the LEC's network TSLRICs also include the costs of providing narrowband special access loops and the interoffice transport associated with these dedicated loops. Thus, while all of the local switching TSLRIC, all of the common transport and tandem switching TSLRICs and all of the signaling and operator systems TSLRICs are properly attributable to switched service; only a portion of the loop and dedicated transport TSLRICs are so attributable.

Outputs from the Line Multiplier Module and the Wire Center Module are used to determine the portions of loop costs and dedicated transport costs that are attributable to nonswitched local services. The remaining costs that are associated with switched service TSLRIC are then displayed.

B. ILLUSTRATIVE OUTPUT

Table 23 displays illustrative results from the HM for Pacific Bell-California.

Table 23 Unit Cost by Network Element -- Pacific Bell - California

Loop Elements	0 - 5 hh/mi2	5 - 200 hh/mi	200 - 650 hh/mi	650 - 850 hh/mi2	850 - 2550 hh/mi2	> 2550 hh/mi2	Totals
<i>Loop Distribution</i>							
Annual Cost	\$42,069,613	\$170,326,755	\$117,488,134	\$41,617,759	\$365,365,318	\$545,637,407	\$1,282,504,986
Units	109,113	1,288,296	1,451,816	584,063	5,367,413	8,634,088	17,434,788
Unit Cost/month	\$32.13	\$11.02	\$6.74	\$5.94	\$5.67	\$5.27	\$6.13
<i>Loop Concentration</i>							
Annual Cost	\$11,970,421	\$63,182,353	\$54,420,087	\$18,399,339	\$120,085,198	\$103,851,184	\$371,908,583
Units	109,113	1,288,296	1,451,816	584,063	5,367,413	8,634,088	17,434,788
Unit Cost/month	\$9.14	\$4.09	\$3.12	\$2.63	\$1.86	\$1.00	\$1.78
<i>Loop Feeder</i>							
Annual Cost	\$2,085,245	\$5,030,115	\$5,331,057	\$2,615,247	\$47,277,814	\$94,858,571	\$157,198,050
Units	109,113	1,288,296	1,451,816	584,063	5,367,413	8,634,088	17,434,788
Unit Cost/month	\$1.59	\$0.33	\$0.31	\$0.37	\$0.73	\$0.92	\$0.75
<i>Total Loop</i>							
Annual Cost	\$56,125,280	\$238,539,223	\$177,239,278	\$62,632,345	\$532,728,330	\$744,347,163	\$1,811,611,619
Units	109,113	1,288,296	1,451,816	584,063	5,367,413	8,634,088	17,434,788
Unit Cost/month	\$42.86	\$15.43	\$10.17	\$8.94	\$8.27	\$7.18	\$8.66
<i>Total Lines</i>	109,113	1,288,296	1,451,816	584,063	5,367,413	8,634,088	17,434,788

Table 23 (continued) Unit Cost by Network Element -- Pacific Bell - California

	Annual Cost	Units		Unit Cost	
End office switching	\$655,911,223				
1. Port	\$196,773,367	14,947,269	Switched lines	\$1.10	per line/month
2. Usage	\$459,137,856	238,082,755,975	Minutes	\$0.00193	per minute
Signaling network	\$44,560,625				
1. Links	\$810,305		Link	\$43.68	per link per month
2. STP	\$33,216,716	178,488,411,302	TCAP+ISUP messages	\$0.00019	per message
3. SCP	\$10,533,603	12,052,424,400	TCAP messages	\$0.00087	per message
Transport network					
1. Dedicated	\$761,329,168	3,559,399	Trunks	\$427.79	per DS-1 equivalent/month
Switched	\$229,267,234	1,071,880	Trunks	\$0.00177	per minute
Special	\$532,061,934	2,487,519	Trunks	10,044	Trunk-minutes/month
2. Common	\$64,108,935	55,739,855,180	Minutes	\$0.00173	per minute per leg (orig or term)
3. Tandem switch	\$109,328,741	30,459,521,088	Minutes	\$0.00359	per minute
Operator systems	\$15,296,019				
Total	\$3,290,378,539				
Total cost per switched line	\$14.89	per line/month			

C. DISCUSSION

Examination of these numeric results suggests that the derivation of the cost of tandem switching should be reviewed. This is because the reported unit cost of tandem switching exceeds the unit cost of end office switching. If revisions to the model are necessary to address properly this issue, this modeling will be updated.

In addition, one of the strengths of this model is its flexible ability to accept newly available data and/or modeling logic flows. As a result, as additional data become available, or new modeling demands are identified, HAI will enhance this tool.

Appendix 1

**PRINCIPLES TO GUIDE STUDIES OF LOCAL EXCHANGE
TOTAL SERVICE LONG-RUN INCREMENTAL COST (TSLRIC)**

1. **TSLRIC measures only the long-run costs of providing the element in question.**
Costs must be measured over a sufficiently long period of time so that any element-specific costs become variable.
2. **TSLRIC measures only the *forward-looking* costs of providing the element in question.**
TSLRIC must measure forward-looking costs, not historic, embedded or book costs. Economic costs are forward-looking and are based on the most efficient generally available technology.
3. **TSLRIC is based on the costs that an *efficient, cost-minimizing* competitor would incur -- i.e., the costs of assets that are optimally configured, sized and operated.**
Proper measures of TSLRIC must exclude the costs of inefficient design or operations, because those costs cannot be recovered in competitive markets and would weaken incentives for LECs to operate efficiently.
4. **TSLRIC includes only the *additional* costs of providing the particular network element(s), holding constant the supplier's output of all other items.**
TSLRIC includes only those added costs that are attributable to production of the network element(s). Costs that are properly attributable to *other* outputs of the LEC, or costs that are fixed and shared with other network elements so that they would be incurred even if the network element(s) were not supplied, are excluded from TSLRIC.
5. **TSLRIC is based on the entire demand of *all* uses and users of a network element.**
TSLRIC includes the economic costs of serving the total demand of all uses and users of a network element, including the demand of the supplying LEC.
6. **TSLRIC should reflect any significant geographic cost differences.**
TSLRIC estimates should reflect any significant geographic differences in cost, to the extent that these cost differences are reliably measurable.

Definitions of the above cost terms are supplied in Appendix 2 to this document.

Appendix 2**GLOSSARY OF COST TERMS**

Forward-looking costs: Costs that an efficient, prospective entrant would consider in investing in an industry, because the entry, exit and expansion decisions of such firms are based on expected costs and revenues.

Joint costs: Costs that derive from the joint production of products in fixed proportions.

Common costs: Costs which must be incurred if any of the firm's products are produced, but are unattributable to individual products on any cost-causative basis. It is a useful convention to limit the term to overhead costs.

Shared costs: Fixed costs that are incurred in the production of a specific subset, or various subgroupings, of all the products of a firm.

Stand-alone costs: Economic costs of producing a product or group of products in isolation from all other products (i.e., on a stand-alone basis).

Embedded costs: Costs of operations that are recorded on the firm's current accounting books.

Fully distributed costs ("FDC"): Cost per unit of output of a product, including directly attributable costs and an allocation of common or shared costs. The allocation of common costs among products is not based on cost causation and is inherently arbitrary.

Overheads: Costs incurred that are involved only indirectly in the production of outputs. Some overhead costs may be fixed and unattributable. Others may vary with the firm's scale and thus be causatively attributable to the production of particular products.

Contribution: Amounts that, on a forward-looking basis, represent the difference between revenues and TSLRIC for a particular product or group of products. These amounts are intended to "contribute" to the recovery of the firm's common costs and shared-fixed costs.

Residual costs: Costs that represent the difference between the firm's current revenue requirement and the sum of the TSLRICs of all of its regulated services.